2. Self-register of the changes of pressures of the gas in the gasometer at Batavia on August 26–28, 1883, showing the disturbance caused by the eruption of Krakatoa.

3. Barograms from Colaba, Bombay, and Aberdeen, Scotland, for the days between August 26 and September 1, 1883, showing the effect of the eruption on the barometer.

4. Copies of photographic records, showing barometric changes at Radcliffe Observatory, Oxford, due to atmospheric waves connected with the Krakatoa eruption.

5. Copies of barograms at the Radcliffe Observatory, Oxford, during the periods of eruptions of Mount Pelée and La Soufrière, May 4–11, 1902.

6. Curves showing the monthly variation of the temperature of the ground at Radcliffe Observatory, Oxford, at different depths, as determined by platinum resistance thermometers, compared with the air temperature in the shade four feet above the surface.

7. *Meteorological thermometer.*—A fine copper wire wound upon a light mica frame is inclosed for protection in a thin brass tube. The wire readily acquires the temperature of the surrounding air, its electrical resistance changing considerably with change of temperature.

8. *The Calendar recorder for continuous registration of temperature.*—The above-mentioned meteorological or resistance thermometer, arranged for taking the air temperature, is included in one arm of a Wheatstone bridge. When the temperature changes, the bridge balance is upset, and this causes the slider to be automatically moved along the slide wire until the balance is restored. When this recorder is applied to the meteorological thermometer, the recorder corresponds to the variations of electrical resistance of the copper wire, the leads between the recorder and the thermometer being so compensated that their variations of temperature are without effect upon the indications.

9. *Sunshine receiver.*—Two flat zigzag windings of fine platinum wire lie side by side within a glass bulb, hermetically sealed, containing dry air. One of these wires is embedded in a thin layer of black enamel, while the other wire is left bright and has no covering except the bulb. When their temperatures are equal, the two wires are of equal electrical resistance, but the effect of direct sunshine is to raise the temperature of the embedded coil above that of the exposed coil, thus giving rise to a difference of resistance, which is registered by the Calendar sunshine recorder. This recorder is similar to the Calendar temperature recorder described above, but the quantity directly recorded is the difference of resistance of two platinum wires. The total sunshine is estimated as a time integral of intensity, by applying a planimeter to the record obtained.

10. *Indicator connected to the earth-temperature thermometer.*—The thermometer, buried at the point whose temperature is to be observed, is similar to the meteorological or resistance thermometer, described above. The platinum wire resistance is included in one arm of a Wheatstone bridge, the remaining resistances being disposed within the body of the indicator, which also contains a sensitive detector galvanometer of suspended coil type. To take a temperature reading, the position of a slider upon a circular slide wire is adjusted by turning an ebonite head at the top of the case until the galvanometer shows that the point of balance has been reached. The temperature is then directly read off on a dial.

11. *Blakesley portable barometer.*—A tube, closed at one end and open at the other, has a uniform bore of about 1.2 millimeters, and contains a thread of quicksilver about 20 cubic meters long. The length of the body of inclosed air is read in two vertical positions. If A is the length in question when the closed end of the tube is uppermost and B when the open end is uppermost, then the required height of the barometer H is given by

$$H = \frac{A+B}{A-B} L,$$

where L is the length of the thread of quicksilver. If L has been measured once for all at 0° C, no temperature correction is required.[1]

12. Diagrams illustrating a paper by Mr. F. W. Harmer on the meteorology of the glacial epoch, originally published in the Quarterly Journal of the Meteorological Society of London.

13. Two glass positives showing the spectrum of lightning. These were secured by Dr. W. J. S. Lockyer on May 31, 1903, 3 a. m., with a Thorpe grating in front of the photographic objective.

14. *Dine's pressure plate.*—This is attached to the head of a vane so as to face the wind. The small holes on the face of the plate all communicate with an air space inside, and since the holes are all of exactly similar construction and size, and are evenly distributed over the whole surface of the plate, the air pressure inside is very approximately the mean of the pressures on the elements of the face of the plate. There is a similar arrangement for the back of the plate, and a similar statement applies to it. The difference of the pressures in the two air spaces multiplied by the area of the plate gives, therefore, the whole force produced by the wind normal to the face.

This difference of pressure is measured and recorded on the chart of an ordinary pressure tube anemometer, and Mr. Baxendell's experiments have shown that if connecting tubes of suitable size be used the errors due to momentum of the moving parts, which vitiate the records of the ordinary pressure plate, are very trifling.

15. *Besson's harrow nephoscope.*—This instrument consists of a long brass rod, mounted in a vertical position in such a manner that it can revolve freely, and bearing at its upper end a horizontal crosspiece provided with a number of vertical spikes. The observer places himself so that the cloud whose direction of motion is to be ascertained appears in the same straight line as the central spike, and then revolves the crosspiece until the cloud appears to move along the line of spikes, while the observer himself remains motionless. The direction in which the crosspiece is pointing is then read off on a graduated circle provided for that purpose. By observing the time taken for the cloud to pass from spike to spike the angular velocity can be determined.[2]

16. *The gravimetric recording hygrometer of Prof. F. T. Trouton.*—The principle on which the action of this instrument depends is that the *weight* of moisture condensed by bodies such as flannel is, within the meteorological range of temperature, approximately a function of the hygrometric state alone. Thus, when the moisture in the air varies, or the temperature changes, the weight absorbed by a piece of flannel also changes; not, however, in proportion to the amount of moisture present, but in proportion to the hygrometric state. This alteration in weight is shown by the movement of the arm of a balance from which the flannel is suspended, and is recorded by means of an inked stylus, on graduated paper, revolving with a clock-driven drum.

17. *The electrical dew-point hygrometer af Prof. F. T. Trouton.*—The moment of deposition of moisture on a hygrometer of the Dines type is announced by the completion of an electric circuit effected by the deposed moisture. Two long parallel wires are affixed to the surface of deposition. These wires form the electrodes of a circuit containing a battery and indicating instrument. While the circuit is dry there is insulation, but on dew forming the current can pass between the wires. The apparatus can be adapted for use with an automatic recording instrument for giving a record of the dew-point at frequent intervals. It is also of use in positions where the moment of deposition of dew can not be observed by the eye.

18. *Sunshine recorder of Mr. A. Lander.*—A novel instrument in which the sensitive paper is stationary, and the pin hole or narrow slit is revolved by means of clockwork. The slit is close to the sensitive surface of the paper. The instrument is made of aluminum, and is small and light. It gives a very sharp and perfect record and is very sensitive.

19. *Anemometer of Mr. A. Lander.*—This instrument records both direction and pressure, the latter by means of a delicately counterpoised rubber bellows, which is raised by the pressure of the wind and lifts a small conical float suspended in glycerine.

20. *Thermograph of Mr. A. Lander.*—Made with a compound strip of extraordinary sensitiveness to temperature, so that it gives a movement of nearly one inch for difference of 10° F. without the magnification by levers.

THE DIFFUSION OF ODORS IN THE ATMOSPHERE.

The Editor has been accustomed to say that one of the direct evidences of the presence of slowly ascending currents of air is to be found by studying the behavior of buzzards, vultures, and other birds that feed on carrion. We see these birds low down in the horizon at the limit of vision, sailing round and round all day long, until finally, sometimes after the lapse of two or three days, they have been able to trace the smell of their food from great altitudes downward to its location on the ground. The distance from which they come, often a hundred miles, and the vertical height from which they have to descend, perhaps 10,000 feet as an extreme case, give us some idea of the gentle slope of these so-called ascending currents, which are twisted and contorted into every imaginable shape by the wind.

[1] Unfortunately, the Editor does not find the name of Blakesley in our index to meteorological literature, and can not refer to the date of the invention of this portable barometer, but it may be worth stating that he himself, quite independently, devised precisely the same method as a method of illustrating the subject to a class of students in 1882. The results obtained by this simple apparatus would be unexceptionable were it not for the effect of the uncertainty of the influence of capillarity in tubes that are only 1 or 2 millimeters in diameter.—*C. A.*

[2] If an ordinary hand rake be set up with the handle vertical, the head bar and the teeth will be horizontal. If the handle turns about its vertical axis, the head bar can be set in such a position that the cloud under observation may appear to travel from one end of the bar to the other. The direction in which the head bar points is then the true azimuth of the motion of the cloud, and its velocity may be determined by counting the number of teeth passed over in one minute. Of course Besson's apparatus applies only to clouds near the zenith. The ordinary nephoscope can be used for clouds within 15° of the horizon. Another form devised by the Editor in 1871, but not yet constructed, would allow of observations down to the horizon itself, if this were ever desired in meteorology.—*C. A.*

The strength of the argument to the effect that the descending track of the buzzard proves the existence of ascending currents of air lies in the assumption that the odor is carried upward by simple convection. Now Prof. John Zeleny, of the University of Minnesota at Minneapolis, has made a study of the rate of diffusion of odors in still air, and has communicated his results to the American Association for the Advancement of Science at its meeting in St. Louis in December, 1903. It is evident that if diffusion were more rapid than convection, then our argument would fall to the ground, but the contrary seems to be the case.

Professor Zeleny writes as follows:

In answer to your inquiry in regard to my experiments on the rate of propagation of smell, I beg to say that I find that smell diffuses very slowly. To prevent the disturbance due to convection currents, the experiments were carried on by having the odors diffuse through glass tubes of small diameter. As an example, it took over two hours before the smell of ammonia was detected at the end of a tube a meter and a half long. For shorter distances, the time required was roughly proportional to the square of the distance.

It seems, therefore, that the rapid way in which an odor spreads through a room is due almost entirely to convection currents.

Your elegant way of proving the existence of ascending currents in the atmosphere surely can not be affected by diffusion phenomena, since their effect is so slow.

I was especially interested in making my experiments to see if the particles producing smell might not be subatomic. The slowness of the diffusion is against this. But we do not know how much stuff is necessary before we can recognize the smell. Ammonia I could detect as soon chemically as with my nose. A peculiarity appears in camphor (large molecular weight) where in a vertical tube the smell ascended twice as fast as it descended. For ammonia, the rates up and down were about the same.

The only gas that I have used that may come from carrion is H_2S. The odor of this was detected at a meter's distance in about 35 minutes. In the formula $t = kl^2$, which applies roughly for short distances, $k = 0.21$ about, for H_2S and 0.27 for NH_3, t being measured in seconds, and l in centimeters; l is length of tube, and t is the time before the odor is detected at one end of the tube from the substance at the other end.

LOW BAROMETER DURING THE "PRESIDENT" STORM OF MARCH 12, 1841.

Prof. George Davidson, of the University of California, in a letter of December 27 to Prof. Alexander McAdie, says:

A case of excessive low barometer is given in Sir George Simpson's journey round the world in 1841-42. He was making the passage from Liverpool to Halifax in the *Caledonia*, Captain McKellar, a vessel of 1300 tons and 450-horse power. He says, on the morning of the ninth day out (March 12, 1841) Captain McKellar discovered that the barometer had fallen between two and three inches during the night, having descended to 26.9, the lowest point which, in his experience, it had ever reached. He then tells about the storm, and mentions that it was in this very storm that the steamer *President* was lost. "My recollection of a high barometer was in a terrific storm from the northwest, some time near the end of November, 1857. I was then off Barnegat (New Jersey), getting home. My memory puts the barometer at 31.4, but that was on shore."

THE MISCHIEF OF WRONG THEORIES.

During the past century there has been such steady progress in all branches of science that the more intelligent portion of the community has abandoned those notions with regard to astrology, alchemy, spontaneous generation, witchcraft, and other philosophies that were formerly accepted by the most learned. The diffusion of education has raised the children of the present generation above the level of the philosophers of a former generation. And yet we have seen it demonstrated again and again that the popular majority does not fully appreciate the extent of our present knowledge of the laws of the weather, and is still liable to resort to unscientific methods in hope of accomplishing that to which science has not yet attained.

We have seen communities in America and Australia carried away with the idea that cannonading can produce rain, or in Europe that the ringing of church bells or the offering of prayers can avert droughts and floods. In southern Europe the agriculturists are but just recovering from the strange belief that hail can be prevented by shooting rings of smoke toward the clouds. During the past ten years a wealthy engineer of Russia has devoted his fortune to the conversion of the people to his idea that the moon controls the weather, and so seriously does his advocacy of this error affect the uneducated agricultural community that the director of the weather service at Odessa (Klossovsky) has gone to the trouble of publishing an elaborate statement of the errors in fact and theory committed by this engineer. He shows very clearly that Demtchinsky's method of predicting the weather by lunar periods amounts to nothing more than predicting an average condition, an average which very rarely occurs, whereas the departures from it are very frequent. The verifications of these predictions are like the combinations in an ordinary game of chance, where there is an equal number of heads and tails, or hits and misses.

As the collection of meteorological statistics depends so largely upon the voluntary work of thousands of unpaid observers, it is to be feared that the good work we are doing in America may be seriously interrupted if erroneous views are allowed to have an influence in this country as profound as they seem to have in southern Russia.

We can not repeat too often and too clearly the general proposition that meteorology is to be advanced only by studying in details the effects on the atmosphere of insolation, radiation, the diurnal rotation and annual revolution of the earth, and the presence of continents and oceans.

AURORA AND MAGNETIC DISTURBANCES OF OCTOBER 30—NOVEMBER 1, 1903.

On October 30, 31, and November 1, some remarkable disturbances of the magnetic needle, a so-called magnetic storm, were reported from nearly all portions of the globe. Attending this great disturbance there also occurred auroras and earth currents on our globe, and sun spots and solar prominences. Of course this combination of phenomena is very common, as it has long been known that they are all associated together, but the magnetic disturbance of October 31 appears to be the most important that has yet been recorded. Although terrestrial magnetism proper is usually considered to be distinct from meteorology, yet the aurora is always included. We have, therefore, collected a few of the records of its recent appearance.

In the Annuaire of the Meteorological Society of France for November, 1903, the editor, M. Th. Moureaux, Director of the Observatory, Parc Saint-Maur (Seine), publishes a short note on this great magnetic perturbation, in which he says:

Magnetic pertubations have been rare and feeble during 1901, 1902, and 1903. But a more intense and long sustained series of pertubations began October 11, and after a calm interval of several days a new series of exceptional intensity began on October 31. This started suddenly at 6:12 a. m. with a simultaneous jump in the declination needle *D* and the horizontal component *H*, and a diminution of the vertical component *Z*. The great oscillations of *D* and *H* began at 7 a. m. and continued without interruption until 10 p. m. Then, between 10 and 11 p. m., *H* fell off greatly, but the phase of maximum density did not occur until about noon. At this moment *Z*, which had been but slightly disturbed thus far, rapidly increased, and the two other elements, *D* and *H*, experienced rapid and great variations. The observers remained constantly at the apparatus, and noted that *D* diminished by 1° 39′ in the interval between 1:52 p. m. and 1:55 p. m., but recovered by about 1° 18′ between 2 and 2:05 p. m. During the rapid movement of the declination needle eastward, the two components *H* and *Z* increased simultaneously in such a way that the total magnetic force also experienced a great increase at this time. Similar great oscillations were observed at 4 p. m., 5.30 p. m., and 7 p. m. In fact, the magnets were troubled throughout the whole night, and it was only at 2 a. m. of November 1 that *Z* returned to its normal value. In general the disturbances drove *D* and *H* below the average and those of *Z* above the normal. The extreme amplitudes of the variations were, respectively, 0.00680, or $\frac{1}{25}$ of its absolute value for the horizontal component; 0.00520, or $\frac{1}{81}$ of its absolute value for the vertical component; 2° 4′ for the declination. Disturbances of the same kind